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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|--------------------------------|------------------------|
| 10/773,183 | 02/09/2004 | Kia Silverbrook | MTB22US | 8428 |
| 24011 7590 05/14/2008 SILVERBROOK RESEARCH PTY LTD 393 DARLING STREET BALMAIN, 2041 AUSTRALIA | | | EXAMINER FIDLER, SHELBY LEE | |
| | | | ART UNIT 2861 | PAPER NUMBER |
| | | | MAIL DATE 05/14/2008 | DELIVERY MODE PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|---|--|
| Office Action Summary | Application No. 10/773,183 | Applicant(s) SILVERBROOK, KIA | |
| | Examiner SHELBY FIDLER | Art Unit 2861 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 February 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6,8,10-22,24,25,27,29-44 and 46-54 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6,8,10-22,24,25,27,29-44 and 46-54 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Responsive Office Action

This Office Action is responsive to the remarks and amendments filed 2/17/2008.

Claim Objections

Claim 3 is objected to because of the following informalities: please change "the bubble forming chamber with a circular cross section wherein the heater" (lines 1-2 of the claim) to "the bubble forming chamber has a circular cross section, and the heater". Such amendments are necessary to place the claim in proper sentence format. Appropriate correction is required.

Claim 17 recites the limitation "the solid material" (line 2 of the claim). There is insufficient antecedent basis for this limitation in the claim.

Double Patenting

Claims 1, 3, 5-6, 8, 10-19, 31, 24-25, 27, 29-38, 40, 42-44, and 46-54 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 3, 5-6, 8, 10-19, 31, 24-25, 27, 29-38, 40, 42-44, and 46-54 of copending Application No. 10/773186 in view of Campbell et al. (US 4870433).

Regarding claims 1, 9, and 38:

Claims 1, 19, and 38 of copending Application No. 10/773186 discloses all claimed limitations except that drive circuitry corresponding to each of the nozzles for controlling the operation of the heater element via electrodes connected between the drive circuitry and the heater element;

Art Unit: 2861

wherein part of the drive circuitry is disposed on one side of the bubble forming chamber, and part of the drive circuitry is disposed on the opposing side of the bubble forming chamber; and

the heater element is configured so that the bubble nucleation section and the rest of the heater element are co-planar and remain co-planar when the heater element is heated.

However, Campbell et al. disclose an ink jet printhead in which drive circuitry (drive circuitry is obvious to the selective energizing of heaters disclosed in col. 1, lines 11-13 & col. 3, lines 8-11) corresponding to each of the nozzles for controlling the operation of a heater element (12) via electrodes (15, 16) connected between the drive circuitry and the heater element (Fig. 7);

wherein part of the drive circuitry (that connected to common electrode 15) is disposed on one side of the bubble forming chamber (Figs. 1, 2, and 7), and part of the drive circuitry (that connected to individual electrode 16) is disposed on the opposing side of the bubble forming chamber (Figs. 1, 2, and 7), and

the heater element being is configured so that a bubble nucleation section (31) and the rest of the heater element are co-planar and remain co-planar when the heater element is heated (Figs. 1 & 3).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize drive circuitry, for controlling operation of the heater element, on both sides of the heater element, and to utilize a heater element in which a bubble nucleation section is co-planar with the rest of the heater element, such as disclosed by Campbell et al., into the invention claimed by Application No. 10/773186. Campbell et al. shows that this modification would have been advantageous, because such a heater configuration produces high pumping efficiency while also greatly reducing cavitation damage to the heater (col. 3, lines 14-19).

Art Unit: 2861

Regarding claims 3, 5-6, 8, 10-18, 31, 24-25, 27, 29-37, 40, 42-44, and 46-54:

These claims are rejected as shown by the following table:

| <i>Claim # of Instant Application 10/773183</i> | <i>Claim # of Copending Application 10/773186</i> |
|---|---|
| 3 | 3 |
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Art Unit: 2861

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| 54 | 54 |

This is a provisional obviousness-type double patenting rejection.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-5, 11-13, 19-22, 24, 30-32, 38-42, 47-48, and 50 are rejected under 35 U.S.C. 102(b) as being anticipated by Campbell et al. (US 4870433).

Regarding claims 1, 19, and 38:

Campbell et al. disclose an ink jet printhead comprising:

a plurality of nozzles (nozzles 19), each nozzle having a respective bubble forming chamber (print cavity 21 – Fig. 2);

at least one heater element (resistive heater element 12) disposed in each of the bubble forming chambers respectively (Fig. 2), the heater element being configured for thermal contact with a bubble forming liquid (col. 3, lines 8-11);

drive circuitry corresponding to each of the nozzles for controlling the operation of the heater element (such drive circuitry is inherent to the selective energizing of heaters disclosed in col. 1, lines 11-13 & col. 3, lines 8-11) via electrodes (electrodes 15 & 16) connected between the drive circuitry and the heater element (col. 3, lines 8-11), such that

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble (bubble 22) that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element (col. 3, lines 8-13); wherein

part of the drive circuitry (that connected to common electrode 15) is disposed on one side of the bubble forming chamber (Figs. 1, 2, and 7); and

part of the drive circuitry (that connected to individual electrode 16) is disposed on the opposing side of the bubble forming chamber (Figs. 1, 2, and 7), wherein

the heater element (12) has a bubble nucleation section (elongated elements 72 & 74) of a smaller cross section (the cross section shown in Fig. 7) than the rest of the heater element (Fig. 7) so that the temperature of the bubble nucleation section is heated to above the boiling point before the rest of the heater element (col. 5, lines 1-22),

Art Unit: 2861

the heater element being configured so that the bubble nucleation section and the rest of the heater element are co-planar and remain co-planar when the heater element is heated (Figs. 1 & 7),

wherein the nozzles are supplied with a replacement volume of the ejectable liquid that is equivalent to an ejected drop (this is inherent to the cyclic ejections disclosed in col. 3, lines 3-7 & col. 4, lines 64-68).

Regarding claims 2, 20, and 39:

Campbell et al. also disclose that the heater elements (12) and the bubble forming chamber (21) are symmetrical about a longitudinal plane (Figs. 1, 2, and 7).

Regarding claims 3, 21, and 40:

Campbell et al. also disclose that the bubble forming chamber (21) has a circular cross section (Fig. 1), and the heater element (12) has at least one arcuate section (elongated elements 71-74) that is concentric with the longitudinal axis of the bubble forming chamber (Figs. 1, 2, and 7) such that, during use, the arcuate section forms a disc-shaped bubble (22 - col. 3, lines 50-58) with a point of collapse that is substantially on the central axis of the bubble forming chamber (col. 3, lines 60-64).

Regarding claims 4, 22, and 41:

Campbell et al. also disclose that the gas bubble (22) encircles at least some of the heater element (col. 3, lines 54-57 & Fig. 2).

Regarding claims 5, 24, and 42:

Campbell et al. also disclose that the bubble forming liquid and the ejectable liquid are of a common body of liquid (col. 3, lines 8-13).

Regarding claims 11, 30, and 47:

Art Unit: 2861

Campbell et al. also disclose that each heater element (12) has two opposite sides (e.g. top side and bottom side of heater 12 shown in Fig. 7) and is configured such that the gas bubble (22) formed by that heater element is formed at both of the sides of that heater element (Figs. 1 & 7).

Regarding claims 12, 31, and 48:

Campbell et al. also disclose that the bubble (22) that each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater element (12) is configured such that the point of collapse of the bubble is spaced from that heater element (col. 3, lines 60-64).

Regarding claims 13, 32, and 50:

Campbell et al. also disclose that the printhead comprises a structure (substrate 18), wherein nozzles (19) are incorporated on the structure (Fig. 2).

Examiner notes the additional limitation that the structure is formed by CVD. However, this limitation is directed towards a method of forming the apparatus, which is not germane to the patentability of the apparatus itself. Because, the structure, as claimed, can be formed by various other methods, this limitation has not been given patentable weight.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 2861

Claims 6, 10, 14, 25, 29, 33, 43, 46, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. (US 4870433) in view of Silverbrook (US 6019457).

Regarding claims 6, 25, and 43:

Campbell et al. disclose all the limitations of claim 1, and also disclose that the printhead is configured to print on a page (col. 1, lines 11-17).

Campbell et al. do not expressly disclose that the printhead is a page-width printhead.

However, Silverbrook discloses a pagewidth printhead that is configured to print on a page (col. 6, lines 7-12).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to make Campbell et al.'s printhead a pagewidth printhead, such as disclosed by Silverbrook. One motivation for doing so, as taught by Silverbrook, is to be able to print on the width of an A4 page (col. 6, lines 7-12).

Regarding claims 10, 29, and 46:

Campbell et al. disclose all the limitations of claim 1, and also disclose that the printhead comprises a substrate (substrate 18) having a substrate surface (top surface of substrate 18 shown in Fig. 1).

Campbell et al. do not expressly disclose that the areal density of nozzles relative to the substrate exceeds 10000 nozzles/cm² of substrate surface.

However, Silverbrook discloses a printhead having an areal density of nozzles relative to a substrate that exceeds 10000 nozzles/cm² of substrate surface (using the reference measurement of Fig. 43, calculations show that the density is 12207 nozzles/cm²).

Regarding claims 14, 33, and 49:

Art Unit: 2861

Campbell et al. disclose all the limitations of claim 1, and disclose a structure (substrate 18), wherein nozzles (nozzles 19) are incorporated on the structure (Fig. 1).

Campbell et al. do not expressly disclose that the structure is less than 10 microns thick.

However, Silverbrook discloses a structure (overcoat 142) that is less than 10 microns thick (col. 9, lines 8-10), wherein nozzles are incorporated on the structure (Fig. 11).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize an overcoat layer, such as disclosed by Silverbrook, onto the substrate of Campbell et al. One motivation for doing so, as taught by Silverbrook, is to provide increased levels of protection against the air (col. 9, lines 5-8).

Claims 15, 18, 34, 37, 51, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. (US 4870433) in view of Kubby (US 5851412).

Regarding claims 15, 34, and 51:

Campbell et al. disclose all the limitations of claim 1, and also disclose that the printhead comprises a plurality of bubble forming chambers (col. 2, lines 48-53), each corresponding to a respective nozzle (Fig. 2).

Campbell et al. do not expressly disclose that a plurality of heater elements are disposed within each bubble forming chamber, wherein the heater elements within each bubble forming chamber are formed on different respective layers to one another.

However, Kubby discloses a plurality of heater elements (doped regions 20) that are disposed within a bubble forming chamber (Figs. 4-5), wherein the heater elements within each bubble forming chamber are formed on different respective layers to one another (col. 4, line 66 – col. 5, line 10).

Art Unit: 2861

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a plurality of the heater elements formed on different layers within each bubble forming chamber, such as suggested by Kubby, into the invention of Campbell et al. One motivation for doing so, as taught by Campbell et al., is to provide an ink ejector that is capable of emitting two distinct droplet sizes (col. 5, lines 11-21).

Regarding claims 18, 37, and 54:

Campbell et al. disclose all the limitations of claim 1, but **Campbell et al. do not expressly disclose** that each heater element is covered by a conformal protective coating that has been applied substantially to all sides of the heater element such that the coating is seamless.

However, Kubby discloses heater elements that are covered on all sides with a conformal protective coating (protective layer of tantalum) such that the coating of each heater element is seamless (col. 4, lines 60-62 & Fig. 4).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a seamless protective coating on all sides of the heater element, such as disclosed by Kubby, onto the heater element of Campbell et al. Kubby shows that such a modification would have been advantageous, because a protective coating prevents corrosion of the semiconductor structures caused by contact with liquid ink (col. 4, lines 37-39).

Examiner notes the additional limitation that the coating had been applied substantially to all sides simultaneously. However, this limitation is directed towards a method of forming the apparatus, which is not germane to the patentability of the apparatus itself. Because, the structure, as claimed, can be formed by various other methods, this limitation has not been given patentable weight.

Art Unit: 2861

Claims 16-17, 35-36, and 52-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. (US 4870433) in view of Chan (US 5870121).

Regarding claims 16, 35, and 52:

Campbell et al. disclose all the limitations of claim 1, but **Campbell et al. do not expressly** disclose that each heater element is formed of a solid material more than 90% of which is constituted by at least one periodic element having an atomic number below 50.

However, Chan discloses a heater element (resistive layer 26, 27) that is formed of a layered titanium/titanium nitride combination (col. 4, lines 62-66).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element formed of titanium/titanium nitride into the invention of Campbell et al, because Chan teaches that such a heater element made of such materials provides good electromigration performance (col. 8, lines 15-26).

Regarding claims 17, 36, and 53:

Campbell et al. disclose all the limitations of claim 1, and also discloses that the heater elements are heated to a temperature above the boiling point thereby to heat the bubble forming liquid to a temperature above the boiling point to cause the ejection of the drop (col. 5, lines 1-22).

Campbell et al. do not expressly disclose that each heater element is configured for a mass of less than 2 nanograms of that heater element to be heated.

However, Chan discloses forming heater elements (resistive layer 26, 27) of more than 2 nanograms of a solid material (titanium/titanium nitride – col. 4, lines 62-66 & col. 6, lines 30-37).

Art Unit: 2861

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to form Campbell et al.'s heater elements of titanium/titanium nitride, such as disclosed by Chan, so that heating of more than 2 nanograms occurs upon ejection. Chan shows that such a modification would have been advantageous, because heater elements made in such a way provide good electromigration performance (col. 8, lines 15-26).

Allowable Subject Matter

Claims 8, 27, and 44 would be allowable if rewritten to overcome the Double Patenting rejection(s), set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Claim 8 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest an ink jet printhead comprising a heater element that is configured such that an actuation energy of less than 500 nanojoules is required to form the bubble to cause the ejection of the drop. It is this limitation, in combination with other features and limitations of claim 8, that makes this claim allowable over the prior art of record.

Claim 27 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest a printer system incorporating a printhead comprising a heater element that is configured such that an actuation energy of less than 500 nanojoules is required to form the bubble to cause the ejection of the drop. It is this limitation, in combination with other features and limitations of claim 27, that makes this claim allowable over the prior art of record.

Claim 44 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest a method of ejecting drops of an ejectable liquid comprising the step of heating the at least one heater element by applying an actuation energy of less than 500 nanojoules. It is

Art Unit: 2861

this limitation, in combination with other features and limitations of claim 44, that makes this claim allowable over the prior art of record.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Silverbrook (US 5796416), for example, discloses heater elements that form a droplet with an actuation energy of less than 500 nanojoules. However, because actuation energy is directly dependent upon the structure and configuration of the heater element, it would be improper to assume that the heating pulse disclosed in Silverbrook would actuate Campbell et al.'s heater element to produce a drop.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Art Unit: 2861

Communication with the USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHELBY FIDLER whose telephone number is (571)272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Luu can be reached on (571) 272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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